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Indian Standard

SPECIFICATION FOR PYRANOGRAPH, BIMETALLIC

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5

March 1985

Indian Standard

SPECIFICATION FOR PYRANOGRAPH, BIMETALLIC

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Indian Standard

SPECIFICATION FOR PYRANOGRAPH, BIMETALLIC

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 14 September 1984, after the draft finalized by the Meteorological Instruments Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 Measurements of the total amount of energy received from the sun and sky are of fundamental importance in meteorology and in the studies of the exchange and transformation of energy in the earth-atmosphere system, and in biology, medicine, agriculture, architecture and industry. The solar radiation which reaches the earth's surface has wavelengths 0·3 to 4 μm (1 $\mu\text{m} = 10^{-6}$ m). The intensity of radiation is expressed as the amount of radiant energy falling on unit area of the surface in unit time and is expressed in mega joules/sq metre (Mj/m^2). The solar constant, the mean value of the intensity of solar radiation reaching a surface placed normal to the rays of the sun just outside the earth's atmosphere is assumed to be 1 367 ± 7 W/m^2.

0.3 The most widely used principal instruments for the accurate measurement of solar radiation are those using thermopile as the sensing element. However, for the routine measurement of total incoming radiation from the sun and sky, instruments using bimetal elements as the sensor are in wide use, though their accuracy and response are not comparable with those using thermopiles. The bimetallic pyranograph falls under this class.

0.4 Bimetallic pyranographs are in use at some radiation stations in the country. With the increasing applications of the knowledge of radiation in many fields, domestic, agricultural and industrial, the interest in the manufacture of radiation instruments is fast building up in the country and many entrepreneurs are contemplating entry into this field. The formulation of an Indian Standard has, therefore, become necessary in the interests of standardization and quality in the production of instruments.

0.5 In the formulation of this standard, due consideration has been given to the requirements laid down by the World Meteorological Organization, Geneva, in addition to the special requirements obtaining in this country.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard prescribes the requirements for the bimetallic pyranograph for obtaining a continuous record of the global radiation from the sun and sky.

2. DESCRIPTION

2.1 The receiving surface of the bimetallic pyranograph is supported on two pillars fixed to the base of the instrument and consists of three bimetallic strips, two painted white and one painted black and held together at one end. The opposite ends of the white strips are fixed to the frame of the instrument. The other end of the black strip is free to move and is connected to a simple lever mechanism, the movements of which are recorded on a chart wrapped around a clock-driven drum. The deflection of the black strip relative to the white strips is proportional to the intensity of radiation received on the sensitive surface and is independent of ambient temperature changes. The receiving surface is protected by a glass hemisphere. A covered glass window at the front to view the record and a silica gel container at the rear are provided in the body of the instrument. A pivoted window at the top of the instrument enables one to remove the clock drum for changing the chart.

3. TYPE

3.1 The bimetallic pyranograph shall be of the type shown in Fig. 1 and 4.

4. MATERIAL

4.1 The base, the body, guard, the top window lid and linkage strip shall be all made of good quality aluminium casting.

4.2 The guide rods, the pen arm components, pen lifter, pillar base, the pillars, linkage chain, bimetal element support, adjustment screw and key, bimetal bracket, bimetal junction plate, dome ring, knurled cover for adjustment screw, knurled window knob and the locking knob, window cover and frame, silica gel container and its components, the various knobs and screws shall all be made of good quality brass.

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*Rules for rounding off numerical values (*revised*).

4.3 All the gaskets shall be of canvas lined rubber or polypropyne or neoprene.

4.4 The pen arm shall be made from nickel silver.

4.5 All the pivots of the linkage mechanism shall be of silver steel, hardened, while the adjustment spring shall be made from phospher bronze alloy.

4.6 The sensitive elements shall be made from 'Highflex 45' bimetal.

4.7 The glass window in the front shall be of good quality transparent glass while the protective dome shall be of glass uniform refractive index and free from visible blemishes, obvious variations in thickness, air bubbles and scratches with uniform refractive index. It shall have the property of uniform transmissibility in the range 0·3 to 4·0 μm wavelength.

5. DIMENSIONS

5.1 The general arrangements, nomenclature and main dimensions of the bimetallic pyranograph shall be as shown in the Fig. 1 to 4.

6. GENERAL REQUIREMENTS

6.1 Base (*see* Fig. 1)

6.1.1 The base shall be of aluminium casting with a rubber sealing gasket. The casting shall be free from blow holes. It shall be provided with an arrangement for securing it firmly to a cement platform and the shape and dimensions shall be so finished that the body shall sit snugly on it and when the base and body are clamped together by the screw, the space inside shall be more or less airtight.

6.2 Pen Arm Assembly

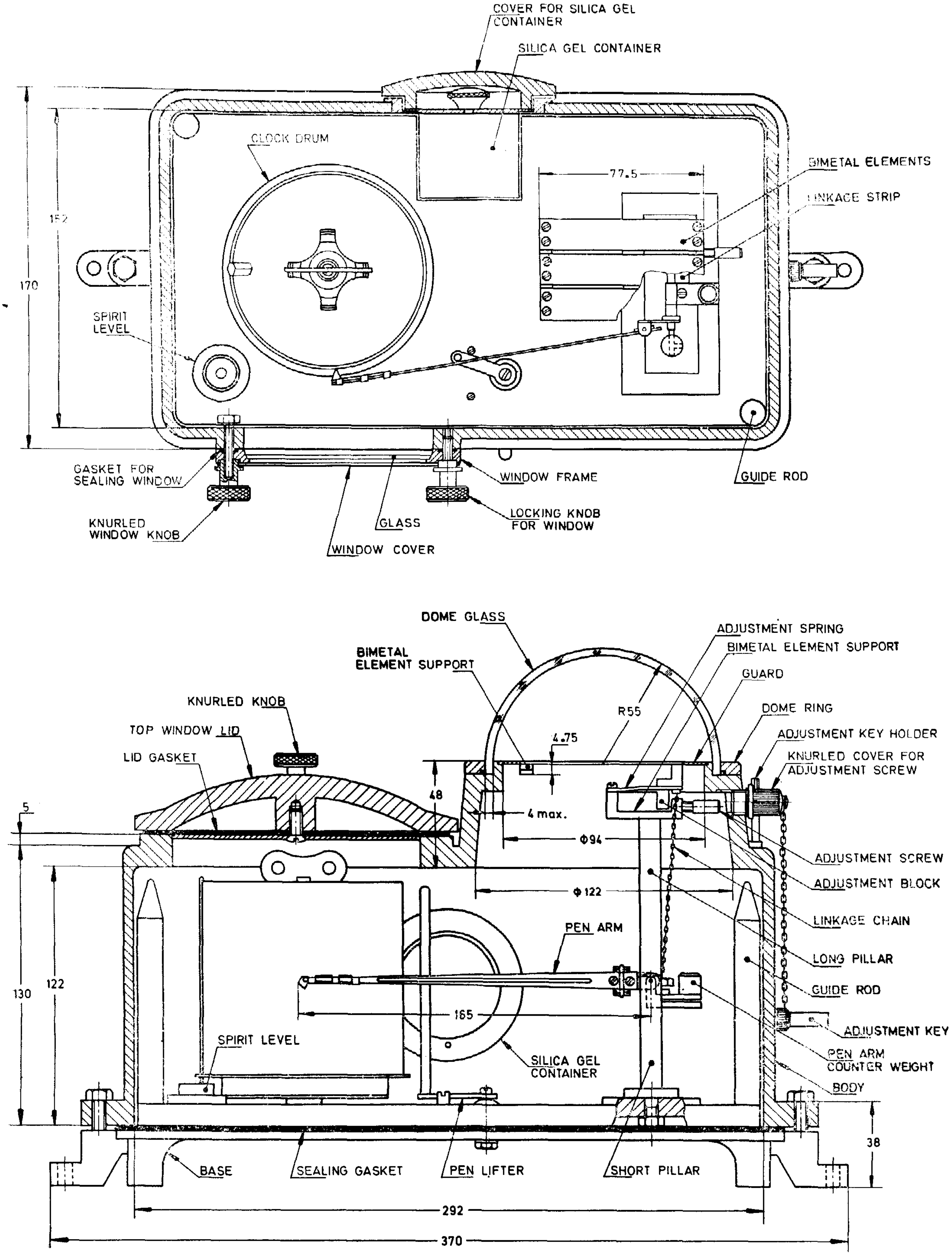
6.2.1 The pen arm shall be made from 0·56 mm thick hard drawn nickel silver sheet and shall be ribbed in the centre for strength.

6.2.2 The pen arm assembly with the bracket carrying the counterweight shall be brazed to the pen arm spindle.

6.2.3 The two holes of the gate suspension shall be so located that the pen arm has always a bias towards the clock drum.

6.2.4 The pen arm disc inside the gate suspension shall not have any vertical play.

6.2.5 The length of the pen arm from the tip of the pen to the pen arm spindle shall be exactly 165 mm.



All dimensions in millimetres.

FIG. 1 NOMENCLATURE AND MAIN DIMENSIONS FOR PYRANOGRAPH, BIMETALLIC

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6.3 Pillar Assembly (*see* Fig. 2)

6.3.1 The short and long pillars shall be turned from brass rod to the dimensions shown in Fig. 2, such that the spindle carrying the pen arm assembly, pivoted between the two pillars is exactly 54 mm from the top surface of the elevated base, near the pillar position.

6.3.2 The pillars shall be brazed to the base in such a way that the two holes meant for the two pivot pins shall be exactly in alignment and facing each other. The pillars shall be fixed to the base of the instrument in this position by means of hexagonal nuts with washers.

6.3.3 The bimetal element support machined from brass, shall be brazed to the top of the long pillars.

6.4 Bimetal Assembly (*see* Fig. 3)

6.4.1 The three bimetal strips, shall be identical in shape and size. They shall be made of the bimetal specified in **4.6** and shall be 1·2 mm thick, 77·5 mm long and 15 mm wide.

6.4.2 The middle strip shall have an undercoat and a top coat of optical black lacquer having excellent absorptive characteristics. The recommended lacquer is Parsons' optical black lacquer.

6.4.3 The two strips on either side shall be painted with white paint of high reflectivity containing either magnesium oxide or titanium oxide.

6.4.4 The bimetal strips shall be fixed at one end to the junction plate and at the other to the bimetal bracket such that they all lie in the same plane.

6.4.5 The brass linkage chain shall be securely soldered to the upper nut at one end and inserted tight in the lower screw at the other.

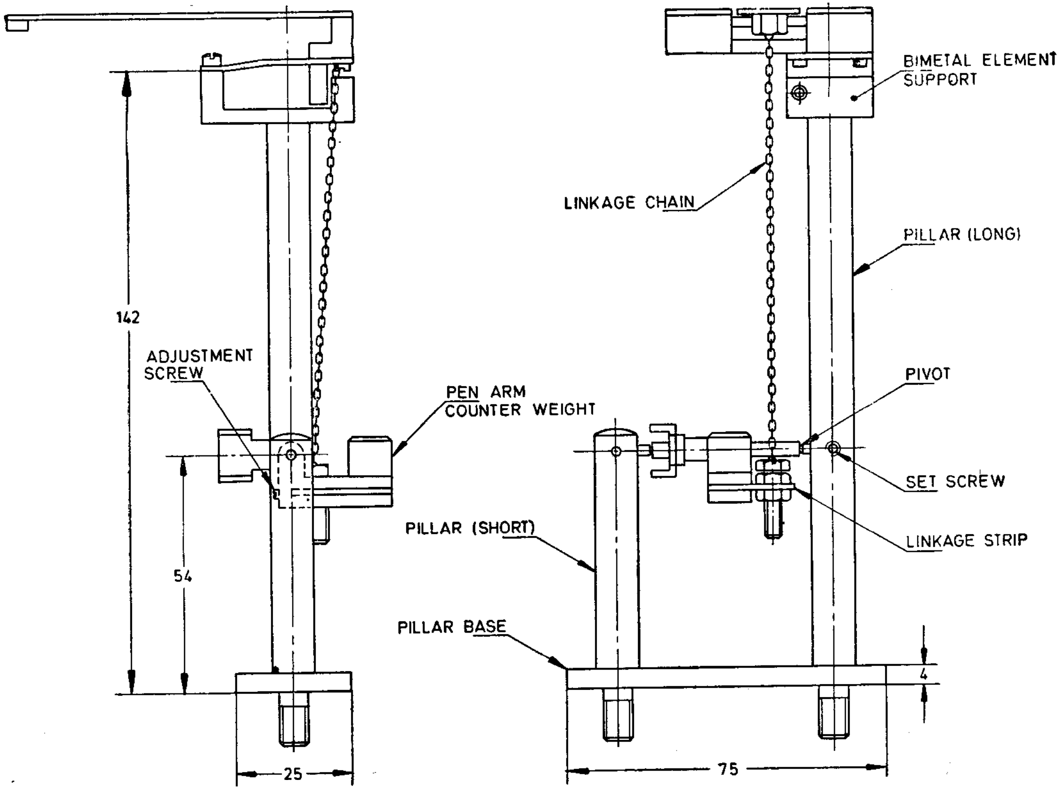
6.5 Cover and Body (*see* Fig. 4)

6.5.1 The cover shall be of aluminium casting and shall be screwed to the body at the rear with a canvas lined rubber gasket interposed in order to keep the space inside more or less airtight.

6.5.2 The window, top window, the silica gel container and the dome shall all be made moisture proof by suitable gaskets made of rubber or orther similar material.

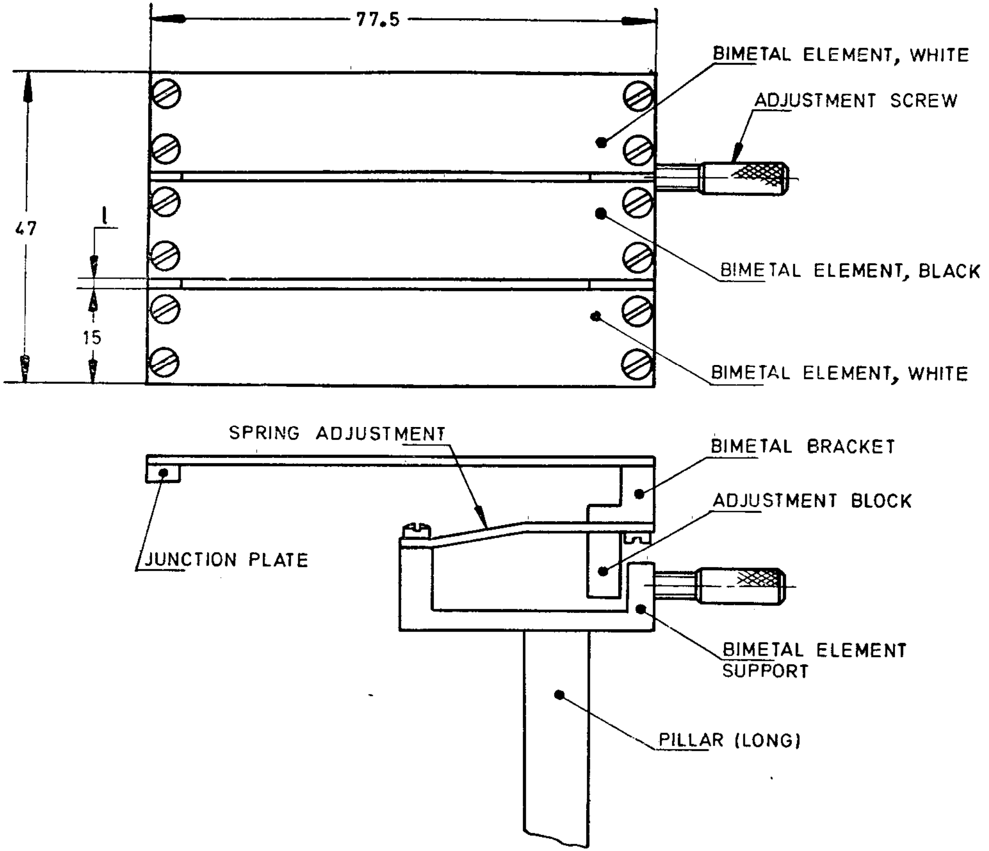
6.5.3 The body shall be cast from aluminium and finished in the shape shown in Fig. 1 and 4 with overall maximum dimensions of 315 × 175 × 170 mm.

6.5.4 The glass of the window in front shall be 90 mm in diameter and be quite transparent so that the record on the drum inside can be seen clearly through it.



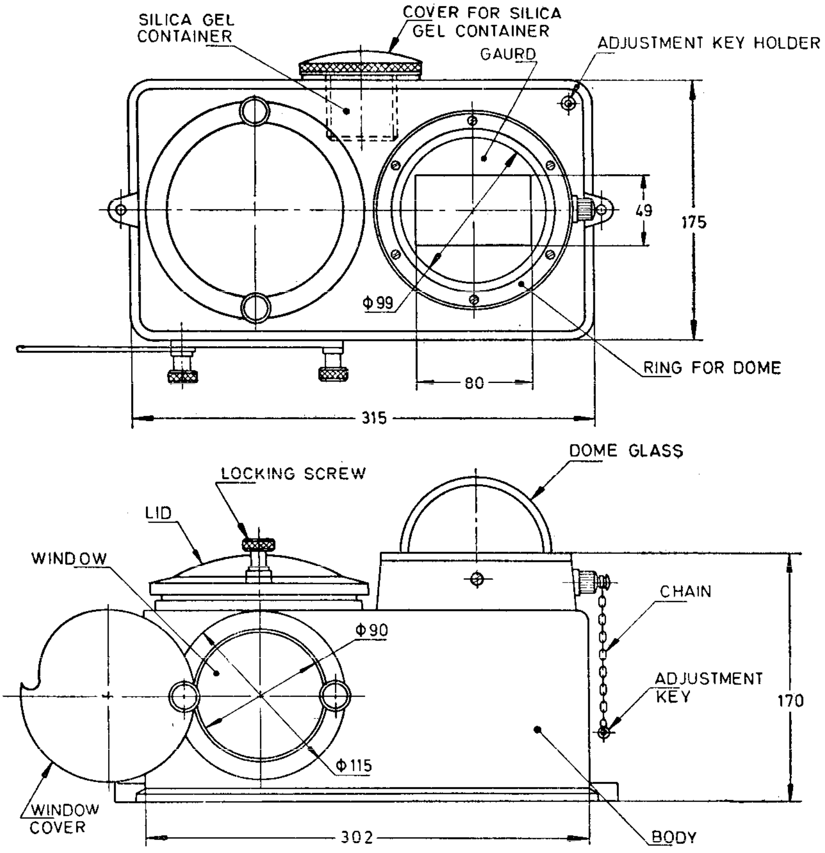
All dimensions in millimetres.

FIG. 2 PILLAR ASSEMBLY FOR PYRANOGRAPH, BIMETALLIC



All dimensions in millimetres.

FIG. 3 BIMETAL ASSEMBLY FOR PYRANOGRAPH, BIMETALLIC



All dimensions in millimetres.

FIG. 4 BODY AND COVER FOR PYRANOGRAPH, BIMETALLIC

6.5.5 The protective dome for the sensitive elements shall be cut from a sphere having 55 mm outside radius, along a horizontal plane 4·75 mm below the centre of the sphere. It shall be kept firmly in position by means of a ring and a rubber gasket which shall also make it moisture-proof.

6.6 Clock Drum and Mechanism with Chart

6.6.1 The instrument shall be fitted with a 'fixed clock' type daily drum and mechanism made according to IS : 5924-1970*.

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*Clock mechanisms and drums for meteorological instruments.

6.6.2 The clockwork mechanism shall be suitably fixed on a washer to raise the drum to the required height, such that the pen exactly traverses along the arcs denoting the time scale on the chart.

6.6.3 A suitable chart having time range of 25 hours, with 1 hour = 11·5 mm and provided with 15 minute time arcs shall be wrapped on the drum. The chart shall have an overall length of 335 mm and overall width of 91 mm with 31 horizontal lines drawn on it, the lowest being numbered 0 and the topmost line numbered 60. The zero line shall be at a distance of 21·2 mm from the lower edge of the chart. The distance between the zero line and the line marked 60, shall be 61 mm (*see* Fig. 5).

6.6.4 The chart shall be printed on excellent quality white chart paper on which the recording ink shall not spread or show tendency to feather.

6.6.5 The chart shall generally be as prescribed in IS : 5947-1970* and shall bear the inscriptions as prescribed in it, besides the name of the instrument, namely, bimetallic pyranograph.

7. WORKMANSHIP AND FINISH

7.1 The glass dome for protecting sensitive bimetal elements shall be absolutely clear, clean and well polished and it shall be free from air bubbles, scratches or other defects. It shall have uniform refractive index at every point.

7.2 With the dome in position, the body clamped to the base and the top lid, front window closed and the silica gel container closed with its cover, the interior of the instrument shall be airtight, with no possibility of ambient humidity affecting the sealed space.

7.3 There shall be minimum friction between the nib of the pen arm and the chart on the clockdrum. While ensuring a continuous record, it shall also be ensured that the pen pressure on the chart is the minimum required.

7.4 The base and the body shall have two coats of good quality primer and finished with stove enamel white paint.

7.5 All brass parts shall be cadmium plated and then polished. The guard for the bimetal elements and the two pivot pins shall be highly polished.

8. SETTING AND ACCURACY

8.1 The bearings shall be clean, smooth and well polished, so as to have a minimum of friction.

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*Charts for recording meteorological instruments.

8.2 The pressure of the pen on the chart shall be so adjusted that when the base is tilted forward at an angle of 30°, the pen shall lift off the chart.

8.3 The time required by the instrument to respond to 98 percent of change in the intensity of the radiation shall not exceed 15 minutes.

8.4 The instrument shall have an accuracy of ± 10 percent in the short term integrated daily totals.

9. MARKING AND PACKING

9.1 Marking

9.1.1 Each bimetallic pyranograph shall have the following neatly and legibly marked on a plate cemented to the base:

a) The name of the instrument, 'BIMETALLIC PYRANOGRAPH';
b) The maker's name or registered trade-mark, if any; and
c) The serial number and year of manufacture, that is, 'No. 123-1981'.

9.1.2 The instrument shall also be provided with a certificate giving the following information:

a) The calibration factor at 0°C expressed in $MJ/m^2/cm^2$ on the chart, and
b) The variation of the calibration factor at different temperatures.

9.1.3 The instrument may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9.2 Packing

9.2.1 The complete instrument with its accessories shall be suitably packed in a stout cardboard carton after removing the clockdrum. The clockdrum shall be separately packed in a smaller cardboard carton and placed inside the larger one containing the rest of the instrument. The carton containing the instrument shall then be packed in a strong wooden box with sufficient soft packing material all round, so as to withstand all normal transit risks.

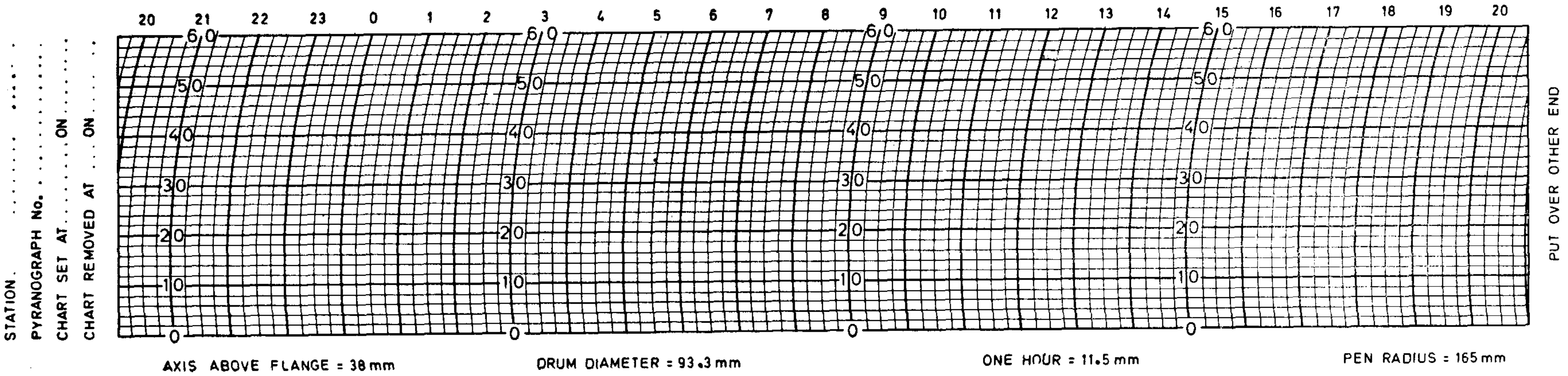

FIG. 5 CHART FOR PYRANOGRAPH, BIMETALLIC

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9.2.2 Alternatively, the instrument with its accessories shall be suitably packed as agreed to between the purchaser and the supplier.

10. INSPECTION AND SUPPLY

10.1 Each instrument shall be inspected individually for conformity to all the requirements of this specification.

10.2 Each instrument shall be supplied with sufficient quantity of suitable charts wrapped in waterproof paper to last about 12 months.

10.3 The instrument shall also be supplied with a phial of suitable recorder ink of the type prescribed in IS : 8277-1976*.

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*Water based recorder inks.

INDIAN STANDARDS ON METEOROLOGICAL INSTRUMENTS

IS:	
4849-1968	Rain measures
5225-1969	Raingauge, non-recording
5235-1969	Raingauge, recording
5793-1970	Aneroid barometers
5798-1970	Mercury barometers
5799-1970	Windvane
5900-1970	Hair hygrograph
5901-1970	Thermograph, bimetallic
5912-1970	Anemometer, cup counter
5924-1970	Clock mechanisms and drums for meteorological instruments
5945-1970	Barograph, aneroid
5946-1970	Whirling psychrometer
5947-1970	Charts for recording meterological instruments
5948-1970	Thermometer screens
5973-1970	Pan evaporimeter
6805-1973	Assmann psychrometer
6806-1975	Snowgauge
6871-1973	Distant indicating wind equipment
7243-1974	Sunshine recorder
7244-1974	Thermometer for mercury barometer
8336-1977	Thermoelectric pyranometer
8693-1978	Net pyradiometer
8754-1978	Electrical anemograph
9085-1979	Correction slide for mercury barometers
10473-1983	Cloud searchlight